

SRB CRITICAL ITEMS LIST

SUBSYSTEM: RANGE SAFETY COMMAND DESTRUCT

ITEM NAME: Range Safety Battery & Recovery Battery

PART NO.: 10400-0888-852 Range Safety
(20 cell)
10400-0888-851 Recovery

FM CODE: A02

ITEM CODE: 70-11, 50-01-01-01

REVISION: BASIC

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 1 and 1

DATE: March 31, 1997

CRITICAL PHASES: Boost

SUPERCEDES: March 1, 1992

FMEA PAGE NO.: F-39

ANALYST: D. Owens/ S. Roney

SHEET 1 OF 5

APPROVED: P. Kalia

FAILURE MODE AND CAUSES: Loss of output voltage from Range Safety Battery and recovery battery (requires two failures) caused by:

- o Open cells or cells
- o Open connector contacts
- o Shorted cell or cells
- o Contaminated electrolyte
- o Open or short internal to case

FAILURE EFFECT SUMMARY: Loss of destruct capability of one SRB, leading to loss of life or injury to the public. Inability to safe the S&A device during a launch scrub results in a hazard to the flight and ground crews until the S&A device can be accessed and mechanically safed. One success path remains after the first failure. Operation is not affected until both paths are lost.

REDUNDANCY SCREENS AND MEASUREMENTS

1. Pass - Output checked and monitored during SIT, Ordnance Installation and final countdown utilizing voltage and current measurements B55V1625C, B55C1051C, B76V1602C and B76C1050C.
2. Pass - Monitored during flight until SRB separation by voltage and current measurements, B55V1625C, B55C1051C, B76V1602C and B76C1050C.
3. Pass - No known credible causes.

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RATIONALE FOR RETENTION:

A. DESIGN

RANGE SAFETY BATTERY (10400-0888-852)

- Features - The Range Safety Battery is the power source for activating the SRB Range Safety Command Destruct System, Channel A.
- The battery is a silver-zinc type generic of those that have survived many times during launch vibration and shocks imposed by launch vehicles. The construction and fabrication technology are similar to other batteries. No failures were experienced on any of the many similar Saturn batteries during launch.
- The battery is activated prior to installation on the SRB. Sufficient monitor time of at least 48 hours in the laboratory is required prior to installation to ensure that the cells do not contain internal shorts through faulty manufacturing. Should a short occur during launch, the battery can be expected to last long enough to complete the SRB flight since it is not anticipated that the temperature would rise fast enough to set the battery on fire. Actually, the battery will most likely perform with a fully shorted cell, although at a lower voltage.
- At launch, the battery would be new and voltage would most likely be in tolerance due to the light load measurements. Survival for 72 hours would not be likely due to the loss of a cell.
- The mass of the battery plus the heat sink provided by the vehicle support structure would hold the heat down. While the battery would get hot, possibilities of a fire within the SRB flight are very low. Test performed by Chrysler several years ago indicated that hard shorts on 35 or 45 AH battery sizes did not result in fires due to the mass of the battery. This is particularly true for the SRB mission time, where the fault occurs during launch. The battery capacity is specified as 50 AH.
- All battery shorts encountered in the past have been on the ground and were a result of faulty manufacturing (such as a missing separator), defect in control electronics (which is not provided in the battery), and exceeded shelf life. These items are detected prior to installation.
- Qualification of the battery assembly is documented in Eagle Ficher ATR-178 and Delta Qual QTR-188 (COQ A-E&I-2123-1). (BI-1712R1)

RECOVERY BATTERY (10400-0888-851)

- O Features - The recovery battery is the power source for activating the SRB Range Safety Command Destruct System, Channel B.
- O The battery is a silver-zinc type generic of those that have survived many times during launch vibration and shocks imposed by launch vehicles. The construction and fabrication technology are similar to other batteries. No failures were experienced on any of the many similar Saturn batteries during launch.
- O The recovery battery is activated prior to installation on the SRB. Sufficient monitor time of at least 48 hours in the laboratory is required prior to installation to ensure that the cells do not contain internal shorts through faulty manufacturing. Should a short occur during launch, the recovery battery can be expected to last long enough to complete the SRB flight since it is not anticipated that the temperature would rise fast enough to set the battery on fire. Actually, the battery will most likely perform with a fully shorted cell, although at a lower voltage.
- O At launch, the battery would be new and voltage would most likely be in tolerance due to the light load measurements. Survival for 72 hours would not be likely due to the loss of a cell.
- O The mass of the battery plus the heat sink provided by the vehicle support structure would hold the heat down. While the recovery battery would get hot, possibilities of a fire within the SRB flight are very low. Test performed by Chrysler several years ago indicated that hard shorts on 35 or 45 AH battery sizes did not result in fires due to the mass of the battery. This is particularly true for the SRB seven minute mission time, where the fault occurs during launch. The recovery battery capacity is specified as 50 AH.
- O All battery shorts encountered in the past have been on the ground and were a result of faulty manufacturing (such as a missing separator), defect in control electronics (which is not provided in the battery), and exceeded shelf life. These items are detected prior to installation.
- O Qualification of the battery assembly is documented in Eagle Ficher ATR-178 and Delta Qual QTR-188 (COQ A-E&I-2123-1). (BI-1712R1)

B. TESTING

VENDOR RELATED TESTING
RANGE SAFETY BATTERY (10400-0888-852)
RECOVERY BATTERY (10400-0888-851)

- Four batteries were qualification tested per QTP-225 and experienced vibration and shock for launch and water impact. A high level of confidence was provided by these tests and a periodic quality maintenance of manufacturing quality.
- Each battery is acceptance tested per ATP-417. Acceptance lists include insulation resistance and dielectric strength lists to ensure integrity of the battery prior to installation.

KSC RELATED TESTING

- The batteries are tested prior to installation per OMRSD File V, Vol. 1 B550FL.240, B550FL.250, B750PL.040 and B750FL.050.
- Battery power is monitored during SIT, pad validation (Ordnance Installation, Part II) and final countdown by RSS battery voltage measurements B55V1625C and B76V1602C, and current measurements B55C1051C and B76C1050C. The requirement and limits of these measurements are specified in "Shuttle Launch Commit Criteria and Background," JSC-16007. (All Failure Causes)
- Battery D.C. power input circuit resistance is verified per OMRSD File V, Vol. I, requirement B55PRO.030.

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS
RANGE SAFETY BATTERY/RECOVERY BATTERY

- USBI QA verifies all weight per SIP 1069.
- Inspection before sealing of assembly cover is verified by USBI per SIP 1069.
- Inspection of cell cover seal, polarity of cells, twisted hugs, damaged terminals and cracks in all case is verified per USBI SIP 1069.
- Inspection of connector leads installation and continuity is verified per USBI SIP 1069.

- O Wiring is inspected and checked for shorts and polarity. Inspection is verified per USBI SIP 1069.
- O Acceptance test is verified per USBI SIP 1069.
- O USBI QAR verifies and monitors dielectric strength, insulation resistance, relief valve test and case seal leakage test; thermistor test is witnessed by USBI QAR.

KSC RELATED INSPECTIONS

- O SPC inspects battery and witnesses test.

D. FAILURE HISTORY

- O Criticality Category 1R
 - o No SRB failure history for this failure mode.

E. OPERATIONAL USE

- O Not applicable to this failure mode.

F. WAIVER/DAR

- o BI-1712R1, 4-11-89, CCBD SB3-01-2291

- SPECIFIED REQUIREMENT:

10CEI-0001, Rev. H, Paragraph 3.2.1.5.9.5d, Power Characteristics.

- DEPARTURE:

The Recovery Battery voltage decay time was not measured during qualification testing and is not presently measured at activation.

- JUSTIFICATION:

Battery voltage is monitored under load at Battery Activation, SIT, Ordnance Installation and Final Countdown. There has been no failure of the associated hardware that can be attributed to a slow OCV to load voltage decay time.